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A DISCUSSION OF KINESCOPE RECORDING AS IT AFFECTS THE EDUCATIONAL TELEVISION STATION

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It is now apparent that the first educational television stations will be widely separated one from the other. This was to be expected because the basic emphasis in the past year has been to interest each state in making its first steps toward the use of television for education. Since this is true, some method must be devised to allow each station throughout the country to make use of the better programs produced by each of the other stations.

In the early days of commercial television broadcasting the program hours were very few. Not many of them would be described as good programs in light of what has been done since. The reasons are obvious. There were just a handful of stations and each had to produce their entire program schedule without the cooperation of any other station. Today it is recognized that stations even in the big markets could not exist if it were not for their connection to the major networks with the tremendous program resources of New York, Hollywood, Chicago and a few other centers. In fact some of the present day commercial stations still do not own a television camera and rely entirely upon film and network services.

The first commercial network programs originated in New York and were fed to Philadelphia. This was back in 1940. WRGB in Schenectady, using a highly sensitive apparatus on a mountain near Albany, was able to receive the New York NBC transmitter and relay those programs to the Albany-Schenectady area. This was the second network station. Soon thereafter Washington was added and then came World War II.

It was not until after the War when the electronic industry was released for civilian work that the network idea began to spread to a point where a single program could reach an appreciable percentage of our nation's population. With this networking came the big television programs of today and now network service is on a coast to coast basis.

The story of educational television, beginning as it does with a pattern like commercial television 10 years ago, is bound to repeat much of the same history but there is a difference. Network connections are extremely expensive and are not economically justified when stations are spaced far apart unless there are lots of intervening stations which can also be served. As noted above, educational stations are to spring up in widely separated areas, basically one to a state or perhaps two. And this will not be in all states for several years. Therefore, network facilities except in unusual circumstances are not economically sound from the point of view of educational television broadcasters.

So we turn next to film. Film production is expensive. Much progress has been made to make it less so with the rapid shooting techniques of the present vid-pix business. The "Groucho Marx" program is shot with six cameras, three of which are continuously in operation. The program is run thru with no stops. Film editors splice together the best parts to make up a half-hour program. "I Love Lucy" has introduced just about all of the short cuts that are possible in the production of motion pictures. It can be argued that there is no reason why motion picture production need be so much more expensive than television production because motion picture cameras could be made more flexible and new production techniques could be evolved. However, every attempt to do this runs head on into the traditional techniques of making motion pictures which has a history of 40 years. It is the old cliché that you find it difficult to teach an old dog new tricks. So, although motion picture production is used to a great extent in commercial television broadcasting, it is probably too costly for extensive use for educational television at least in the first few years.

This leads us to kine recording by which a television program is reduced to a 16mm or 35mm motion picture by the simple method of placing a motion picture camera in front of a bright television receiving tube and turning out a finished product. This method takes advantage of all the short cuts of television production, including its ability to make use of electronic switching and electronic-optical effects and adds only a small cost to the overall budget of the production.

Why then has the kinescope recording taken second place?

This is a matter of quality. There has been a constant struggle to improve this recording process to a point that its utility is unquestioned.

Most of you are fully aware that a television image is made up of a series of lines and therefore its resolution in a vertical direction is limited by this line structure. In practice this figure comes out to be something over 400 lines. In the horizontal direction, the resolution can be better and is only limited by the ability of the engineer to make the scanning beam finer to resolve additional detail. It is common in good studio practice to achieve a resolution equal to 600 lines in the horizontal direction. This is about the best that one can do with the present standards of television.

How then does this resolution capability compare with motion picture?

It can be proved that a 16mm reversal film can resolve detail a little better than the best that television can deliver. 35mm film can resolve a good deal more. Therefore, if everything is working properly we can record all of the information in a television image on either 16mm or 35mm film by the use of proper cameras and proper recording monitors.

When the kine recording is played back thru a television system and re-broadcast it can be shown that some of the detail present in the film will be lost because the scanning beam of the pickup tube may occassionally scan partially in between the lines of the recorded image on the motion picture. In practice a figure of 70% is a measure of the success of re-transmitting kine recordings. This is the reason why a kine recording must, for a long time, look a little worse than a good direct television image.

As between the use of 16mm film and 35mm film theoretically there is very little to choose, practically there is much to choose.

A 35mm film has so much more area and is capable of so much more resolution that if this be taken as 100% and we try to record a television picture output which has an efficiency of 70% or so, 70% of this 100% turns out better than 70%

of the resolution possibilities of a 16mm film, which, relative to 35mm film, might have a figure of merit of 75. In other words, we start with a medium which gives you more margin for error. Unfortunately, 35mm film is costly and during the early days of educational television, will be completely impractical as a recording medium, except in special cases.

This leaves us then with 16mm film as our recording medium. This leaves us also with a difficult assignment if we are to achieve high quality. The margin for error is very slight.

Perhaps what most people do not realize who are entering this business, is the fact that a good kine recording is much more than the output of a good kine recording device. All elements in the system must be working as near optimum as possible.

Of first importance is lighting. Image orthicon tubes which are used in television cameras are extremely sensitive and can operate at very low light levels. But they work better at higher light levels. The output picture will be quieter in the sense that it will have less grain if at least 75 foot candles of key lighting are available in the studio. Then we can operate the image orthicon in its most favorable range.

With this basic level of light it is now important to create the illusion of depth and to minimize the flatness of a television image. Afterall, television is a monocular medium (a one-eyed monster). The only way in which the illusion of depth in a picture can be created is in the skillful use of lighting. We have found that lighting a subject from overhead in such a way that light hits the back of his shoulders will set the subject away from the scenery. If you watch big television shows you will notice that this is done. The depth effect can be further accentuated by the skillful use of spot lights and shadows. These are achieved by lighting one side of the subject to a higher level than the other. This latter type of lighting is known as modeling. With modeling and back lighting we can create the illusion of depth in a television image and give it a character which improves the overall quality.

Next in importance is the cameraman who must at all times keep the camera at optimum focus. This is not as easy as it sounds because all the television cameraman has to look at is a small television tube which presents essentially the same picture as you see in your home. Since we normally operate our studio camera at an f number of about 8, there is a considerable depth of focus which means that it is hard to determine the center plane of focus. It was really better in the old days when we had two separate lenses. One might be operated at f8 focussing the image on the pickup tube. The other lens which was oriented in the same plane as the action lens was operated wide open, forming an image on a ground glass which the cameraman viewed. With this lens wide open he could make a much more critical adjustment of focus, and thus improve resolution.

Next in importance is the operation of the camera chain itself. It takes a skillful camera control operator to get the best out of an image orthicon television chain. Only experience will show him how to do it. There are basic principles which the manufacturers of the tube will be glad to show them, but the niceties depend upon an interested individual operator.

Finally we come to the kine recorder itself. The recording monitor portion of the equipment must be of extremely high quality. One of the most important factors is to have absolute interlace in the picture. As you know, a television image is made up of scanning lines. We scan first lines 1, 3, 5, etc. to the bottom of the picture and return to insert lines 2, 4, 6, etc. If the even lines do not lie precisely midway between the odd lines we will lose resolution in the vertical direction and in the horizontal direction too, because of the interference of one line or the other. This interlace is not easy to achieve and it must be a prime consideration in the selection of equipment. The problem is further complicated by the fact that the recording camera is a mechanical device which sets up vibrations. These may be transmitted to the recording tube and move it just enough to effectively destroy interlace.

Assuming that the monitor is all it should be we must next consider the recording camera.

Never before has the requirement been placed on the motion picture camera that it shall run for long periods of time without cleaning. Hollywood practice is to take a one or two minute scene and then clean the camera gate and proceed. This is because in most motion picture cameras a pressure shoe is used to hold the film securely against the back plate when the film is in the camera aperture. This is done to assure that the film is perfectly flat and that the picture image will be in focus. These pressure shoes, unless very skillfully designed, will chip off bits of the emulsion. These chips often cling to the shoes and build up a hard bump which will scratch the film. Most recording cameras today have dealt successfully with this problem. One company in particular, has dealt with the problem by eliminating it. No pressure shoes are used. Instead there are holes in the back plate to which suction is applied, holding the film in a flat plane by this method. Thus, the emulsion never touches anything in going thru the camera.

There is one other trick in video recording which is important. The television image occurs at a frame rate of 30. A motion picture must be made at a frame rate of 24. This is accomplished by recording one television frame and then throwing away one-fourth of the next frame so far as time is concerned. During this period the film camera pulls down the film for the next frame exposure. One-fourth of a television frame is 1/120 of a second which is very little time indeed. This means that the camera pull down mechanism in a recording camera has to be very rapid and this again contributes to vibration.

In some cameras a mechanical shutter is used to cut off the light from the film while the film is in motion. This shutter has to be very carefully adjusted or otherwise there will appear in the picture a faint horizontal line which we know as the splice line. One manufacturer gets around this by eliminating the shutter. The cathode ray tube is turned on and off at appropriate intervals. This can be readily done because in electronics these phenomena can be controlled in terms

of micro-seconds. So we can see that video recording is a big problem but when carefully done you will be surprised by the excellence of the 16mm films which will result.

Kine recorders can produce a negative or a positive depending upon the polarity of the television image which is presented to the camera. This is a relatively simple thing to do because every time a television signal passes thru an amplifier tube it goes from a positive picture to a negative picture or vice versa. If it is desired to make a lot of prints for distribution to other stations we would make a kine recording by photographing a positive image. When our film is developed it will then be in negative and can be used to make prints in the usual way.

The recording of sound can be done in two ways, photographic or magnetic. Only one recording camera records the sound on the same film as the picture in the proper spatial relationship. The others may have sound recorders added which record the sound at a longer spacing interval from the camera gate. In this case the relationships are adjusted when the prints are made.

A better way is to provide a method of synchronizing a magnetic tape recorder to the recording camera. Such devices are available and you come out with a separate picture film and separate sound tape from which high quality reproductions can be made.

The NBC and other great networks have devised standards for controlling the quality of kine recording and these standards will be made available as you get into operation. They have also set up procedures to align equipment and to balance one camera with the others and to institute proper lighting to the end that the final result will be acceptable for syndication.

Good kine recordings can be made on 16mm film and we in the educational television broadcasting stations will have to learn how to do this. Our rewards will be the exchange between stations of many programs which will cut down individual operating budgets. And as a by-product we will have one of the largest sources for new film material to be used in the audio-visual libraries of our schools and colleges.

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